METHOD FOR MANUFACTURING THIN-FILM MAGNETIC HEAD SLIDERS

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates to magnetic heads in general, and, in particular, to magnetic heads used in magnetic storage devices. Still more particularly, the present invention relates to a method for manufacturing thin-film sliders for magnetic heads to be used in magnetic storage devices.

2. Description of Related Art

In a magnetic recording apparatus such as a hard disk drive, a magnetic head is typically utilized to facilitate the process of information recording. Specifically, a thin-film slider is commonly mounted on a magnetic head, and the thin-film slider is disposed so as to face a recording surface of a magnetic recording medium such as a disk within a hard disk drive.

Conventionally, a thin-film magnetic head slider is manufactured according to the following steps. First, multiple thin-film magnetic heads are formed on a wafer made of a ceramic material. Subsequently, the wafer is cut into multiple row bars by using a dicing saw or the like. Each of the row bars includes multiple magnetic head sliders. The surface of the row bars are polished. Next, each of the magnetic head sliders are etched to a predetermined shape by an etching process. Finally, each row bar is cut into individual magnetic head slider.

The present disclosure provides an improved method for manufacturing thin-film sliders for magnetic heads to be used in magnetic storage devices.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment of the present invention, an elastic layer, which may be made of poly-dimethyl siloxane (PDMS), is initially spun on a wafer and is thermally cured. Then, a resist layer is spun on the elastic layer. Both the resist layer and the elastic layer are subsequently peeled off together from the wafer. Next, the peeled resist layer/elastic layer is applied onto a group of magnetic heads with the resist layer in direct contact with the magnetic heads. Finally, the elastic layer is peeled off from the resist layer such that the resist layer remains attaching to the magnetic heads.

All objects, features, and advantages of the present invention will become apparent in the following detailed written description.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention itself, as well as a preferred mode of use, further objects, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figures **1a-1c** are graphical illustrations of a method for forming thin-film magnetic head sliders, according to the prior art;

Figures **2a-2f** are graphical illustrations of a method for manufacturing thin-film magnetic head sliders, in accordance with a preferred embodiment of the present invention; and

Figure **3** is a high-level logic flow diagram of a method for coating a resist layer onto a group of non-planar magnetic head sliders, in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawings and in particular to Figures **1a-1c**, there are depicted graphical illustrations of a method for forming thin-film magnetic head sliders, according to the prior art. Initially, a group of magnetic heads is processed to a bar shape. The magnetic heads are then cut away from a thin-film magnetic head wafer and the air bearing surface, and are processed to an appropriate pole depth. Generally, ten to twenty magnetic heads **11** are arranged in a row and adhered to a supporting sheet known as a base, such as a base **12**, for machining, as shown in Figure **1a**. Base **12** can be sheet-like shaped or block shaped, and can be made of aluminum, stainless steel, or ceramic or the like.

A wax-based adhesive **13** is commonly used to temporarily hold magnetic heads **11** to base **12**. Wax-based adhesive **13** is applied by rubbing a solid wax onto base **12** that has already been heated to a temperature higher than the softening temperature of wax-based adhesive **13**. Alternatively, a wax layer can be formed by spin coating wax that has been dissolved into an appropriate solvent. Magnetic heads **11** are then pressed onto wax-based adhesive **13**, and wax-based adhesive **13** is gradually cooled to achieve adhesion between magnetic heads **11** and base **12**, as depicted in Figure **1b**.

Next, an appropriate resist material is coated onto magnetic heads **11**, and is subsequently exposed and developed, thereby obtaining a resist mask **15** that reflects the cavity pattern, as shown in Figure **1c**. Then, a dry etching process, such as ion milling, is used to etch the part of magnetic heads **11** to obtain the desired cavity shape.

Finally, each of magnetic heads **11** is cut to form a magnetic head having a distinctly shaped magnetic head slider. The peeling of a completed magnetic head slider from base **12** can be performed by either heating wax-based adhesive **13** to above its softening temperature or immersing base **12** into an organic solvent.

A typical process for performing lithography on sliders requires planarization between rows of sliders (or between single sliders) before resist spin coating. Despite the planarization step, severe topography exists between sliders (approximately 25 microns). Spin coating on this highly non-planar surface will result in large resist thickness variation that can adversely affect control of critical dimension of line width and also subsequent ion-milling. Moreover, sliders are mounted on rectangular carriers that results in automatic yield loss from edge-beading during spin-coating.

The present invention solves the above-mentioned problems by providing a method for coating an uniform resist layer onto a group of non-planar sliders bonded on a rectangular carrier. The method of the present invention involves spin-coating a resist layer on a flat medium with low surface energy, and then transplanting the resist layer onto a group of sliders by an application of heat and pressure. The flat medium facilitates the coating of a uniform resist layer while its low surface energy with respect to the surface of the sliders allows the transfer of the resist layer from the flat medium onto the sliders. Poly-dimethyl siloxane (PDMS) is preferably used as the transfer medium.

With reference now to Figures **2a-2f**, there are depicted graphical illustrations of a method for manufacturing thin-film magnetic head sliders, in accordance with a preferred embodiment of the present invention. Initially, a PDMS layer **22** is spun on a silicon wafer **21**, as shown in Figure **2a**. Silicon wafer **21** is preferably a five-inch wafer. After the completion of spinning PDMS layer **22** on silicon wafer **21**, silicon wafer **21** is placed in an oven at a temperature of approximately 110 °C for the duration of approximately 8 minutes for the purpose of curing PDMS layer **22**.

Then, a resist layer **23** is spun on PDMS layer **22**, during which an edge bead is performed to recess resist layer **23** from forming at the edge of PDMS layer **22**, as shown in Figure **2b**. Resist layer **23** is preferably a positive tone resist, though negative tone resists are also acceptable. After the completion of spinning resist layer **23** on PDMS

layer **22**, silicon wafer **21** is placed in an oven at a temperature between approximately 70 °C to 80 °C for post applied bake.

Next, the combined resist layer **23**/PDMS layer **22** is peeled off from silicon wafer **21**, as shown in Figure **2c**. With the use of a roller **20**, the combined resist layer **23**/PDMS layer **22** is applied onto a group of magnetic heads **24** resting on a carrier **25**, as shown in Figure **2d**. For the application of the combined resist layer **23**/PDMS layer **22** onto magnetic heads **24**, the temperature is preferably 25 °C and the pressure is preferably 1 psi.

Subsequently, PDMS layer **22** is peeled off from resist layer **23**, as shown in Figure **2e**. As a result, resist layer **23** is left on top of magnetic heads **24**, as shown in Figure **2f**.

Referring now to Figure **3**, there is depicted a high-level logic flow diagram of a method for coating a resist layer onto a group of non-planar magnetic head sliders, in accordance with a preferred embodiment of the present invention. Starting at block **30**, an elastic layer, such as a PDMS layer, is initially spun on a wafer, as shown in block **31**. Then, the elastic layer is cured at approximately 110 °C for about 8 minutes, as depicted in block **32**. Next, a resist layer is spun on the elastic layer, as shown in block **33**. Both the resist layer and the elastic layer are subsequently peeled off together from the wafer, as depicted in block **34**. Next, the peeled resist layer/elastic layer is applied onto a group of magnetic heads with the resist layer in direct contact with the magnetic heads, as shown in block **35**. The application of the peeled resist layer/elastic layer onto the magnetic heads is preferably performed by a roller. Finally, the elastic layer is peeled off from the resist layer such that the resist layer remains attaching to the magnetic heads, as depicted in block **36**.

As has been described, the present invention provides a method for manufacturing thin-film sliders for magnetic heads to be used in magnetic storage devices. PDMS has two very desirable properties that makes PDMS a good medium for transferring a resist layer. First, PDMS has a very low surface energy that facilitates resist transfer. Second, PDMS can be molded from liquid to any shape and size. In addition, PDMS is re-usable.

Spin coating, as described above, is a preferred method for forming a PDMS layer of a wafer. An alternative method to spin coating is molding PDMS material on a large sheet and the sheet is then cut to a required size. The molded PDMS layer can be made sufficiently stiff so that the resist layer can be spun coated directly onto the molded PDMS layer without the use of the wafer.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.